Classification / Designation
Changed to / Remplacée par Unclassified / Unlimited
By Authority of
Sur l'Autorisation de DRDB HQ DRP

Date 7 May 1999 Signature Bradley
Appointment / Fonction DRDB HQ DRP Secretary
Unit / Unité DRDC IM 3-2

ANNUAL REPORT OF THE CHAIRMAN,

DEFENCE RESEARCH BOARD

SEPTEMBER, 1951

A: DEFENCE RESEARCH

B: SERVICE DEVELOPMENT PROGRAMS
(Prepared by the Services)

#67133

D. R. C. LABORATORIES
OCT 31 1952
OTTAWA

O T T A W A

20 September, 1951

105-03793/

ANNUAL REPORT OF THE CHAIRMAN, DEFENCE RESEARCH BOARD

SEPTEMBER, 1951

A: DEFENCE RESEARCH

5011 This report by the Chairman is intended to serve as a guide to the Board's discussions concerning plans for the fiscal year 1952-53. It therefore consists of a very brief review of finance, organization, staff and program for the past year and a suggested plan for the ensuing year. Scientific and technical details can be found in the Annual Report of the Board and in the following annual reports which have been issued in the past year. //

Annual Report on	No.	Date
1. The Progress of Operational Research	DR 30	Oct. 50
2. The Progress of Electrical Research	DR 31	Nov. 50
3. The Progress of Defence Medical Research	DR 32	Oct. 50
4. The Progress of Naval Research	DR 35	Apr. 51
5. The Progress of Special Weapons Research	DR 36	May 51
6. The Progress of Armament Research	DR 37	Feb. 51
7. The Progress of Environmental Protection Research	DR 39	June 51
8. The Progress of Arctic Research	DR 40	Sep. 51

Finance

1950-51

The Defence Research Board estimates for research for 1950-51 were approved in the amount of $11,800,000 (round figures). Of this amount, $11,000,000 were spent. Without any explanation, it would appear that unexpended cash amounted to $800,000. This was not the case, however, because while estimates of $11,800,000 were approved, only $11,300,000 cash was made available for spending. The unexpended cash, therefore, amounted to $300,000 as at March 31, 1951, as compared with $1,200,000 as at March 31, 1950.

The carry-over of $3,000,000 was considerably higher than previously. The detail of carry-over as at March 31, 1951, is as follows:

Construction	$1,950,000
Equipment	600,000
Extramural Contracts	250,000
Miscellaneous	200,000
Total	$3,000,000

1951-52

The Defence Research Board estimates for research for 1951-52 were approved in the amount of $16,600,000 (round figures). As of August 31, 1951, $15,300,000 had been encumbered. Cash in the amount of $4,800,000 has been spent, an increase of $2,000,000 over last year at this time.

The amount of unexpended cash as at March 31, 1952, is even less predictable than in the past because supervision of construction has now been taken over by Defence Construction Limited, a division of the Department of Defence Production.

The following is a comparison of expenditures for 1950-51 with estimates for 1951-52:

	Expenditures 1950-51	Estimates 1951-52
Salaries	$ 3,800,000	$ 5,100,000
Operating Costs, etc.	3,400,000	4,500,000
Capital Costs (building only)	2,200,000	6,000,000
Extramural Research (Grants and Contracts)	1,600,000	1,000,000
Total	$ 11,000,000	$ 16,600,000

Organization

The new National Defence Act, which was passed by Parliament in the summer of 1950, provided for the appointment of a Vice Chairman to the Defence Research Board. Mr. E. Ll. Davies, who had formerly held the position of the Vice Director General of Defence Research, took up this new appointment in April, 1951. Concurrently the positions held by Dr. G. S. Field and Dr. J. J. Green as Deputy Directors-General of Defence Research, and Mr. G. W. Dunn as Administrative Deputy, were redesignated. Dr. Field became Chief of Division A, with primary responsibility for Naval research interests, Dr. Green became Chief of Division B, with primary responsibility for Air Force research interests, and Mr. Dunn became Chief of Administration. At the same time, Mr. G. M. Carrie was recalled to Ottawa from London, where he had been serving as Defence Research Member of the Canadian Joint Staff, and appointed Chief of Division C, with primary responsibility for Army research interests. This strengthening of the senior staff at Headquarters has made possible a redistribution of duties, which has helped in meeting the greatly increased demands for research and development assistance from the Armed Forces.

An organizational development of considerable importance was the setting up by the Government, in December, 1950, of the National Aeronautical Research Committee, and the creation of the National Aeronautical Establishment. This mechanism for meeting the need for a greatly expanded program of research, both in military and civil aviation, marks the beginning of a new era in Canadian aeronautical research. Developments at the National Aeronautical Establishment since its inception are discussed in a subsequent section of this report.

As a means of facilitating closer supervision of the Board's electronic research program, the Radio Physics Laboratory and the Defence Research Electronics Laboratory were united for purposes of direction and administration, under the new title of Defence Research Telecommunications Establishment, with Mr. F. T. Davies as Superintendent.

Staff

The recruiting of professional and technical staff was accelerated during the year. The actual progress is shown in the following table:

	Aug. 50	Aug. 51	% Increase
Scientists	242	352	45
Technical Officers	-	41	-
Administrative Staff (Professional Grades)	x 25	22	-
Administrative and Technical Staff (Non-Professional Grades)	1020	1304	28
Seconded Service Personnel	29	21	-27
Consultants (on monthly rates)	4	7	75
Personnel on loan	12	7	-41
Seasonal	135	185	37
Casual	160	198	24
	1627	2137	31

x This figure included two teachers no longer employed as Administrative Officers.

During the winter of 1950-51, all universities in Canada granting degrees in science or engineering were visited by representatives of DRB and the National Research Council. All interested post graduate students and under-graduates in science and engineering were interviewed, and again the Board had a very encouraging response. Over 500 applications were received for full-time employment. Increased competition from industry offering higher salaries, particularly in the fields of engineering, reduced the number of acceptances.

The Board continued its policy of further training for employees, and during the year 10 members of the staff were assisted financially or granted leave without pay to return to university. In addition, 10 students were given financial assistance in completing their training for a degree and have now reported for work with the Board. It is planned to continue this latter scheme for another year.

During the year, 157 non-professional employees were granted permanent appointments. Additional ones are now being selected. Professional staff who have demonstrated their competency are continuing to be given three-year term appointments. A limited number have been granted permanent appointments.

During the summer of 1951, 174 students were employed by the Board. In addition, 26 university staff members joined the Board for this period.

Some progress was made during the year in adjusting salary ranges for the senior members of the staff, and in conjunction with the Civil Service Commission and the National Research Council, an increase was obtained for all employees. At the present time a further adjustment is under consideration.

Good progress was made in recruiting technical officers and technicians. In addition, active steps have been taken by our larger laboratories to train high school and technical school graduates for technical positions.

In view of the unprecedented demand for engineers and scientifically trained staff, greater efforts will be required this year if the present rate of expansion is to be maintained. It is quite obvious that higher salaries must be offered during the coming year if the Board hopes to attract the better qualified scientist.

The proposed establishment increase to 600 professional positions and the necessary technical and administrative staff as authorized by the Board at its Nineteenth Meeting is currently being reviewed with Treasury Board officials, and a favourable decision is anticipated.

Construction

General

From the time the Defence Research Board commenced its operations, there has been a shortage of adequate and suitable research accommodation. The five-year construction program planned in 1949-50 was designed to provide the additional facilities progressively. However, the accelerated defence program created the need for expanding research activities without delay. This, in turn, necessitated immediate steps being taken to have the five-year construction program completed in three years. To this end, design contracts were secured for all the major construction projects planned. By the end of 1951, the plans and specifications will be completed and construction contracts should be awarded by 31 March, 1952. The construction period for the larger laboratories will be from 15 to 20 months. This means it will be the end of 1953 before the laboratory buildings, as now planned, can all be provided.

In October, 1950, the Department of Defence Production was organized for the handling of defence contracts. Defence Construction Limited, a government agency under this department, was established for awarding and supervising defence construction contracts. It was considered that by having all aspects of construction contracts under the control, administration and supervision of one body, construction progress would be expedited. Unfortunately, the desired effect has not been achieved. As well, the valuable contact between the contractor and the administrative staff of the Board has been lost because of the transfer of the administrative and supervisory authority.

Construction contracts which got under way early in 1950 have generally kept to their construction schedule. Construction projects which were not commenced until late in 1950 and early in 1951 are behind schedule, mainly because of the supply of building materials. During the year, the Board has had several construction projects delayed because of the shortage of steel.

The construction of an administration building as part of the Shirley Bay Development has been deleted from the construction program.

During the year, it has been necessary to erect two prefabricated buildings for laboratory use in the Ottawa area and to rent accommodation for laboratory purposes in Toronto.

The program of rehabilitating existing buildings at Grosse Ile, Suffield and Valcartier continued throughout the year.

Major Construction Projects Completed or Under Way as of 31 August, 1951

(a) CARDE

(i) Chemical Laboratory - completed - cost $140,000.

(ii) Ballistics Laboratory will be completed July, 1952 - estimated cost $475,000.

(iii) Enclosed Range will be completed October, 1951 - estimated cost $230,000.

(b) SES

(i) Shopping and Recreation Centre - completion has been delayed until October, 1951 - cost $265,000:

(ii) Transport Garage - construction delays have occurred - completion expected October, 1951 - cost $125,000:

(iii) CMHC Housing - 29 of the 76 houses have been occupied. The remainder will be completed progressively by November, 1951. Expected cost approximately $11,000 per unit.

(iv) CMHC School - 6 rooms - completion expected October, 1951.

(v) Trial Area E has been developed and a square mile fenced.

(vi) Station Fire Hall is under construction - cost $60,000 - completion expected November, 1951.

(c) NRE - The new naval laboratory will be completed during February, 1952 - estimated cost $675,000.

(d) DREL - The new laboratory will be completed in December, 1951 - approximate cost $690,000.

(e) DRNL - A new laboratory wing has been designed and is being constructed - estimated cost $450,000. A cold chamber capable of reaching -65°F is being installed.

(f) Shirley Bay Development

(i) RPL - The electrical bonding and shielding of the laboratory building has delayed construction progress and completion is not expected before February, 1952 - construction cost $500,000.

(ii) DRCL - Construction has commenced on a main chemical laboratory, a pilot plant and a respirator development laboratory. Completion expected October, 1952 - cost approximately $800,000.

(iii) Construction of the central services building and power distribution system has commenced - expected cost $200,000.

(g) NAE - Construction of the hangar laboratory, garage, cafeteria and steam power plant for the Flight Research Section commenced in August, 1951 - estimated construction cost $2,250,000 - target completion date 1 September, 1952.

Major Construction Projects Which will be Commenced before 1 December, 1951

(a) CARDE - Extension to Development Wing Machine Shop. Construction contract expected to commence October, 1951 - estimated construction cost $250,000 - target completion date March, 1952.

(b) DRKL - Construction of a new laboratory to commence during October, 1951 - estimated construction cost $300,000 - target completion date June, 1952.

(c) DRML - The new medical laboratory will be constructed at Downsview Airport, Ontario. Construction should commence October, 1951. Estimated construction cost $1,500,000 - target completion date 1 November, 1952.

(d) Shirley Bay Development - A contract for the construction of water system, sewerage system and heating system will commence October, 1951 - estimated cost $225,000.

Major Construction Projects Which will be Undertaken if Possible During the Fiscal Year 1952-53

CARDE

(i) Administration Building - plans and specifications will be completed October, 1951 - preliminary cost estimate $350,000.

(ii) Extension to central heating plant is being designed.

SES - Central Laboratory Building - plans and specifications will be completed December, 1951 - preliminary cost estimate $1,250,000.

PNL - New Naval Laboratory - plans and specifications completed October, 1951 - preliminary cost estimate $450,000.

Shirley Bay Development

(i) Central Stores Building - plans and specifications completed November, 1951 - preliminary cost estimate $350,000. This building will include a cafeteria.

(ii) Central Workshop Building - design will commence October, 1951 - preliminary cost estimate $175,000.

SUMMARY OF ACTIVITIES BY ESTABLISHMENTS

HEADQUARTERS

Scientific Staff

In last year's report note was made of the need for additional senior scientific staff officers to cope with the expansion of the Board's establishments and the growing volume of research and development effort in industry and other agencies which is being coordinated and directed by the DRB staff. The first and most important step in meeting this need

was the creation of three Scientific Divisions, A, B and C, described previously in this report. In addition, senior scientific staff officers have been appointed in the fields of electronics and special weapons. A further strengthening in this latter field has been accomplished by the appointment of Dr. Otto Maass as Scientific Adviser, Special Weapons, and the creation, under his chairmanship, of a Special Weapons Coordinating Committee, which reports to the Chiefs of Staff Committee.

The supervision and coordination of medical research has been strengthened by a reorganization of the defence medical research committee structure, the appointment of Dr. C. H. Best as Defence Medical Research Adviser to the Board, and the appointment of Dr. J. Doupe, on a part-time basis, as executive secretary of the Defence Medical Research Coordinating Committee.

Directorate of Scientific Intelligence

The policy for national defence, including defence research, is conditioned at least in part by the nature of the threats of potential enemies. Estimates of those threats together with the means of carrying them out are produced cooperatively by the Intelligence Directorates in NDHQ and others, in which task Scientific Intelligence plays an increasingly important role.

During the past year our small group of scientific intelligence officers, the majority of whom are fairly new to the work which has not hitherto been done in Canada, has been hard pressed by the urgent demands of the Chiefs of Staff, External Affairs and others for current appreciations relating mainly to the threat and the nature of a possible major war. Very good progress in carrying out this work was made. For example, as clear a picture as it is possible to draw from the information possessed by the West is now available to Canada on the progress of intelligence and technology and the development of new weapons and new methods of warfare in potential enemy countries; additional examples are appreciations of the probability of war breaking out which give some guidance for the planned time-scale of defence research, and papers on various aspects of atomic warfare which are being made use of extensively by Civil Defence as well as the Services.

By 1952, when new recruits have been trained, we should have in Canada for the first time a suitable nucleus of scientific intelligence officers with the necessary "know-how" and good working liaison with the Directorates of Scientific Intelligence in the U.S. and U.K.

Administrative Services

Under the direction of the Chief of Administration the Directorates of Research Personnel and General Services have continued, with a relatively small but highly versatile staff, to cope successfully with a heavy administrative load. The appointment of Dr. J. A. Pearce as Director of Research Personnel in May, 1951, high-lights the strenuous efforts being made to recruit the additional scientific staff required to meet the expanding research program. At the same time, additional staff have been assigned to the heavily over-loaded supply and construction sections of the Directorate of General Services.

Civil Defence

Scientific problems applicable to Civil Defence cut across the whole field of scientific research. Some investigations already in hand, especially medical problems of treatment of burns and radiation injuries,

have their application in Civil Defence. Many other problems, particularly those relating to fire starting and spreading, have not been well investigated. Some work on the fire problem has now been initiated. A development program for radiation detection instruments has been started, including an investigation of chemical methods of measuring radiation intensity. A large proportion of the effort of the Civil Defence Section is devoted to answering scientific problems which arise in various Civil Defence planning groups.

Joint Intelligence Bureau

The Joint Intelligence Bureau, which is administered by DRB, is responsible to the Joint Intelligence Committee of the Chiefs of Staff organization for all economic, geographic and transportation intelligence for defence purposes. A large part of its effort is employed in day to day tasks of meeting the requirements for staff appreciations by the Chiefs of Staff organization and the Services, and in keeping in touch with activity in all areas of intelligence interest. Detailed basic studies are also undertaken. During the past year the basic work has been to compile a Canadian Intelligence Survey of Canada, which is part of a program to provide essential information on JIB subjects for the defence of North America. With the exception of certain studies of Inland Water Transport, all major subjects will be compiled by the end of 1951. The staff of JIB reached full complement during the summer of 1951.

International Liaison

The volume of information on defence research and development being exchanged between the United Kingdom, the United States and Canada has continued to expand rapidly during the past year. The number of DRB-sponsored visitors to U.K. and U.S.A. defence research establishments has more than doubled and there has been a corresponding increase in visits of defence scientists from these countries to Canada.

The policy of exchanging scientists between U.K. and Canadian defence research establishments and of sending junior Canadian scientists for training in U.K. establishments has proven most successful.

The Defence Research liaison offices in London and Washington continue to represent the Civil Defence Coordinator's interests in the U.K. and the U.S.A. despite the transfer of responsibility for civil defence from the Department of National Defence to the Department of National Health and Welfare.

As the emphasis in defence research and development continues to shift in the direction of immediate applications for use by the fighting forces, the importance of close and continuous liaison becomes increasingly great. It is essential that the liaison staffs both in the United States and the United Kingdom be strengthened as rapidly as possible, and steps are now being taken to this end.

Brigadier G. P. Morrison became the Defence Research Member, Canadian Joint Staff, London, on August 1, 1951, succeeding Mr. G. M. Carrie, who returned to Canada to take up an appointment as Chief of Division C at DRB HQ.

Operational Research Group

Accomplishments in the field of operational research are reflected most concretely in the issue of reports describing completed analyses or evaluations of operational problems. Since the last annual progress report thirteen separate memoranda or reports have been produced.

An additional twenty-one memoranda or reports are either in a draft stage pending publication or have been submitted to DSI for reproduction and circulation but have not yet been issued.

Of the foregoing thirty-four reports, seven have related to problems of air defence. The largest of these is an evaluation of the relative effectiveness of radar and airfield sites in the Canadian air defence system, carried out cooperatively by DRB and RCAF staff. Two reports have dealt with problems of anti-submarine operations; one of these is a general evaluation of the present and prospective state of anti-submarine warfare. Eight reports have been prepared by the Canadian Army Operational Research Establishment, several of which deal with the assessment of infantry support weapons. Two reports concern problems of atomic warfare. Ten are in the field of human resources research (selection, training, human engineering, morale and leadership).

During the past year there have been instituted in addition to the operational research sections already existing in the Army, Air Force Headquarters, and DRB, two new sections, one with the RCN and the other at Air Defence Command HQ. A sixth section is being planned to be located with the Joint HQ for maritime operations. In cooperation with the Army a small team has been sent to Korea attached to HQ 25 Canadian Infantry Brigade. Provision is being planned for similar representation of operational research in connection with future Canadian commitments in Europe. Plans have also been worked out in some detail in conjunction with the Army and RCAF for a program of research on problems of military operations in the North. Work has commenced on several problems in close association with DRNL. Preliminary study of the need for special attention in DRB field establishments and the Services to the design, conduct and reporting of field trials and exercises has also commenced.

At this date ORG professional staff has increased to thirty from total strength of ten one year ago. It is expected that by the end of 1951 this number will have increased further to approximately forty.

Canadian Armament Research and Development Establishment

The past year has been one of real accomplishment at CARDE. The scientific staff has increased from thirty-seven to fifty-two, an RCAF detachment has been set up and is contributing actively to the work of the establishment, and the construction of essential facilities is well advanced. As a consequence considerable progress has been made in the four principal projects, which are:

An Air-to-Air Guided Missile Weapon System
The Heller Infantry Anti-Tank Weapon
Sabot Ammunition
The 75/24 Canadian Pack Howitzer.

Air-to-Air Guided Missile Weapon System

The preliminary study phase of this project was completed in November, 1950, and the resulting proposals approved by an ad hoc technical committee of U.S. and U.K. guided missile experts. The detailed design of the components of the system is now under way. The National Aeronautical Establishment is collaborating with CARDE on aerodynamic problems. A contract is being negotiated with Canadair Limited of Montreal, for the design of the basic air frame, and full-scale test vehicle firings are planned for late autumn, 1951. The Defence Research Telecommunications Establishment is undertaking the development of a suitable proximity fuze, and is collaborating with CARDE on the design of a suitable guidance system. CARDE

has already completed preliminary design of a fragmentation warhead. Control of fragmentation was good, and full-scale warheads are now being made up.

The Heller

Development of the 3.2 inch platoon weapon is well advanced. About 2000 projectiles and 7 projectors should be completed by the end of the year, and 2 pilot models are to be turned over to the Army for user trials in November, 1951. Preliminary design and ballistic studies have been made for a larger weapon to penetrate up to 20 inches of armour, but the final design will not be settled until early in 1952.

Sabot Ammunition

The 17-pr. pot sabot shot designed at CARDE has been accepted by the U.K. and Canada as the standard 17-pr. anti-tank armour-piercing ammunition. The same shot was accepted by the U.S. Army for use in the 76 mm. gun which is mounted in the new light tank known as the "Walker Bulldog". The U.S. shot, of course, uses a different cartridge case.

The 75/24 Canadian Pack Howitzer

The final detailed drawings of the pack howitzer have been completed, as has a pilot model of the ordnance. A pilot model carriage is being manufactured under contract and is due to be completed late in 1951.

Accuracy firings for the HE shell for the pack howitzer were disappointing. As redesigned shell will not be available until late autumn 1951, range and accuracy trials may have to be completed in England during the coming winter.

Suffield Experimental Station

Under the direction of Dr. E. A. Perren, who this autumn completes his two-year attachment from Porton as Chief Superintendent, Suffield has had a most successful year. An increase of seven in the scientific staff, coupled with the recruitment of a number of technicians, has enabled the program of field trials and research to advance at an accelerated pace. New equipment has been developed for field sampling which extends the temperature range under which apparatus of this kind can be operated. One result of the combination of increased staff and improved apparatus is that Suffield can now carry out on the same day, trials with chemical, bacteriological, and radiological materials.

Field investigations of a variety of American and British munitions charged with G agents, particularly under low temperature conditions, have been carried out.

Design of the Iroquois flame thrower has been completed and a number of equipments manufactured for trial by the Canadian Army and by U.S. and U.K. agencies.

In 1950, BW trials were resumed after a lapse of some years, and were continued on an increased scale during the past summer. The facilities at the BW trials area have been considerably improved and this has made it possible, for the first time, to use more than one agent.

Field dispersal and subsequent testing of radioactive material was carried out at Suffield this year, with the object of checking the

theoretical dosages which should be obtained, and to investigate methods of decontamination.

Work on the dispersal and properties of solid particulates, particularly by the use of a high speed photographic technique, has produced results which have a direct bearing on the design of munitions.

Construction effort has been directed primarily towards the completion of facilities at the village of Ralston, where the Suffield staff live. The shopping and recreation centre and seventy-six new homes are due to be completed this fall.

Defence Research Chemical Laboratories

The past year has seen an appreciable increase in the scale of activity at DRCL, both in terms of the number of scientists employed and of projects under way. The scientific staff has been increased by six, to bring the total to twenty-eight. Several other scientists have accepted positions and will be reporting later in the year.

There has been a noticeable increase in the requirements of the armed services, both for the solution of technical problems and for the development of new types of equipment. To meet these requirements a study is being made of the operation of batteries at low temperatures, work is being carried on on some of the technological problems of radiological defence, and development is under way of a "case, water-testing, poisons" and a "case, water-testing, sterilization" for the RCAMC.

To date it has not been possible to obtain from commercial sources, large quantities of consistently satisfactory "Octal", required by the Army as a thickening agent for flame thrower fuels. As a consequence, the DRCL pilot plant has had to operate on a twenty-four hour day - seven day week basis to meet the urgent operational and training needs of the Army. Some of the material produced has been shipped to Korea for the use of the 25th Infantry Brigade.

The search for new toxic agents has been continued, and the investigation of the incendiary properties of chlorine trifluoride and its coordinated compounds has been completed except for some field work.

Plans have been completed for the new laboratories, which will consist of a main laboratory building, a respirator development laboratory with assembly facilities, and a chemical pilot plant. The construction contract for these three buildings, which are to be erected at Shirley Bay, near Ottawa, has been let, and work commenced last July 30th.

Defence Research Kingston Laboratory

The program of research at DRKL on a variety of BW problems has continued on the same limited scale as in past years. However, a site adjacent to the Army camp at Barriefield for a new and considerably larger laboratory has been obtained. Plans for the new building are nearly completed, and construction will start this fall. It is hoped that it will be ready for occupancy in the autumn of 1952.

The staff of the laboratory has been cooperating actively in the BW trials program at Suffield. In addition, work has been going on at Kingston on the development of a method for the large-scale production of botulinum toxin of a high state of purity and corresponding increase in potency.

Two of the holders of the bacteriology fellowships initiated this year by DRB will be studying at Queen's University and will work largely on DRB problems. It is expected that this new fellowship plan will be of considerable assistance in expanding the staff of DRKL when the new laboratory is completed.

Grosse Ile Experimental Station

Since the end of the war, GIES until this year had been closed down, except for occasional use by scientists of the Department of Agriculture. This year, however, the program of research at GIES under the direction of Dr. C. A. Mitchell, Chief of the Division of Animal Pathology, Department of Agriculture, and Chairman of the Defence Research Board's BW Panel, has been greatly expanded.

In order to facilitate the conduct of the experimental work throughout the year, a section of the station has been opened up to operate on a year-round basis. This involved reconditioning of some of the buildings and alterations to the water, electricity and heating services. A new boat has been built for use in communicating with the mainland, and steps are being taken to construct a small landing strip.

The research program at GIES has been concerned with a new production method for rinderpest vaccine, and a study of Newcastle disease, which is of interest not only because the virus is a possible agent, but also because it may provide useful information relating to the behaviour of other viruses.

Naval Research Establishment

Good progress was made during the year in the expansion of the Naval Research Establishment at Halifax. The professional staff was increased from thirteen to twenty-three and the total complement from thirty-nine to sixty-five. This expansion, which is being continued in the current year, has severely taxed the laboratory accommodation available in H.M.C.S. "STADACONA", but the inconvenience of overcrowding has only to be accepted for a short time since it is confidently expected that construction of the large new laboratory for NRE at Dartmouth will be far enough advanced to permit occupation by March next.

Research and development towards production of a variable-depth towed asdic - Project "Dunker" - has comprised the major effort of the Underwater Physics and Engineering Groups. An additional experimental ship - the 250-ton Motor Vessel "La Have" - has been purchased to enable more rapid progress to be made on this project in future. Another step taken during the year, which is already contributing greatly towards progress on "Dunker" and other Anti-Submarine projects, was the establishment of an Information Exchange Project in the general field of Underwater Acoustics between DRB and the U.S. Navy. This enables a very free flow of information and exchanges of visits and apparatus between DRB and U.S. Navy scientists working on allied A/S topics.

Collaboration between NRE and the U.S. Navy during the year included the major oceanographical investigation of the Gulf Stream known as Operation "Cabot" The U.S. participants in this Operation expressed the opinion that H.M.C.S. "NEW LISKEARD", carrying the NRE scientific party, made a greater contribution to the success of the operation than any other single vessel taking part.

The Physical Chemistry and Metallurgy group had the satisfaction of seeing the technique of cathodic protection of ships' hulls pass beyond the experimental and developmental stages to its operational acceptance

and adoption by the RCN for reserve ships and for some small active ships. The group was able to expand very greatly the amount of scientific assistance and advice it could give to Dockyard Departments towards solving their varied technical problems. This led to the suggestion, which commended itself to the Superintendent, H.M.C. Dockyard, and has since been implemented, that the Dockyard Chemical and Metallurgical Group should be transferred to the direction of the NRE.

Pacific Naval Laboratory

During the past twelve months the staff of PNL has grown considerably and now includes fourteen scientists, thirteen technicians, and an administrative group of six. Activities are being restricted for the most part to studies related to the performance of underwater sound. Very close liaison is being maintained with the Pacific Oceanographic Group, Nanaimo, and the Institute of Oceanography at the University of British Columbia.

In the underwater sound field, PNL is carrying out a cooperative program with NRE in the development of the deep-towed asdic, "Dunker". While NRE is placing its major effort on the engineering development of a towed body, PNL has been given the task of determining how such a device will perform under a wide variety of water conditions. The inland waters of the British Columbia coast are ideal for this purpose.

Plans for the construction of permanent buildings for PNL are progressing satisfactorily. A site has been obtained from the Navy and plans for the laboratories are now being prepared. It is hoped to start construction in 1952 with a view to completion in mid-1953.

Defence Research Telecommunications Establishment

As noted earlier in this report, action was taken in February, 1951, to unite the Radio Physics Laboratory and the Defence Research Electronics Laboratory for purposes of direction and administration, under the new title of Defence Research Telecommunications Establishment, with Mr. F. T. Davies as Superintendent. The progress of the two component laboratories is reported in the following sections.

Radio Physics Laboratory

RPL is responsible for research into radio propagation and allied physical properties of the atmosphere, and for consultant engineering in this field. The project of highest priority is the development of an early warning radar system based on the Doppler principle, designed to provide a cheap radar fence across the Arctic. It will be ready for first tests this fall. Other important activities are the development of a new high frequency prediction service for high latitudes to meet the needs of the armed forces, the investigation of low frequency communications systems for use in the Arctic, and a continuation of research in radio propagation in all frequency ranges, with particular emphasis on arctic propagation.

Electronics Laboratory

The main tasks at present assigned to the Electronics Laboratory are the design of a guided missile control system for the air-to-air missile being developed at CARDE, and research and development in specified areas of the communications field.

During the year the professional staff has expanded from eight to nineteen. The total strength of the laboratory is now fifty-nine. A new permanent building adjacent to the Canadian Signals Research and Development Establishment, on the Montreal Road near Ottawa, is nearing completion, and it is hoped to have part of the building occupied by the end of October, 1951.

The chief project to date has been to investigate methods of obtaining multi-channel communications equipment for portable use, requiring a minimum of quartz and with minimal power requirements. This has progressed to the point where a demonstration model will be available shortly.

Several members of the staff have spent considerable time at CARDE in order to become familiar with the GM project before commencing work on the design of a GM control system.

Defence Research Medical Laboratory

DRML was established in Toronto in June, 1950, so that this report, in effect, is a record of the accomplishments of the laboratory's first year. The program of the laboratory is concerned with the investigation of the occupational medical problems of the armed forces. As a consequence it tends to consist of a large number of relatively small projects. Under the general heading of Physiology, work was done on motion sickness, and the effect of cold on joints. Under Toxicology, investigations were carried out on the hazards from operating gasoline pressure stoves, the toxicology of G agents and ACFS, the screening of new compounds for toxicity, and the effect of cortisone on pulmonary oedema and fibrosis. A great deal of work was done on food and nutrition problems. Studies have been undertaken to develop a variety of ration packs for the armed forces, consultations have been held with the food industry on packaging problems, and a variety of tests have been carried out to determine food acceptability. Work is also in progress on problems related to anoxia, on personnel research and human engineering, and on clothing development.

DRML is housed for the present, with the Institute of Aviation Medicine, at the RCAF Station, Toronto. During the past year the staff has grown from eighteen to one hundred and sixteen, of which thirty-two are scientists. There is an urgent need for proper accommodation, and the plans for a new laboratory, to be built at Downsview Airport, are nearing completion. Construction work is to start this fall, and it is hoped that the building will be ready for use by the end of 1952.

Defence Research Northern Laboratory

During the past year the operations at DRNL have changed considerably in nature. Prior to June, 1950, this station served primarily as a base to which various groups of investigators came to work on specific projects of their own for short periods of time. With the completion of the new wing (the second) of the Laboratory in September, 1950, much more work space became available, thus permitting an expansion of the scientific program. Simultaneously an increased number of married and single quarters were completed and it was therefore possible to engage married scientific personnel and the associated technicians and assistants as permanent members of the establishment. Three professionals only were employed as of May, 1950, seven others being added during June and July.

The laboratory staff does not yet include all of the scientific disciplines ultimately envisaged for it. At least one mechanical engineer,

one physicist and one medical graduate (M.D.) will be required in addition to the three persons who are to be employed for operational research. The staff could probably have been built up more completely during the year had more married quarters been available. By January, 1951, however, the DRNL allotment of such quarters had risen only to eight. With the completion of the present construction in January, 1952, five to seven more are expected. It is estimated that ultimately approximately twenty-three should be available for DRNL.

With the increase in the staff which was possible during the year a much larger scientific effort was possible. The investigations at present under way encompass the following:

1. Operational research analyses of northern military excercises. This has led to the recognition of a fairly large number of discrete problems, a number of which are to be investigated in detail at DRNL, the remainder to be undertaken by the Operational Research Group.

2. Field trials on pack rations, tentage and terrain trafficability.

3. Effect of cold and insects on the psychophysiological factors involved in manual dexterity, audition and vision.

4. Gross physiological changes in man resulting from short exposures to cold and the effect of training and acclimatization on them.

5. Chemical and bacteriological changes in human waste deposited on tundra and muskeg (in cooperation with the Surgeon-General, U.S. Army).

6. Vegetation in the sub-arctic, because of its importance to trafficability, in the interpretation of air-photos and because of its possible use to supplement emergency rations.

7. The rearing of northern mosquitoes so that adults will be available for investigations on protective measures throughout the year instead of only during two months.

8. The physiological characteristics of typical arctic warm-blooded (lemming) and cold-blooded animals which enable them to survive in the Arctic.

A decision was made during the year to increase the physical plant at DRNL by building a third wing joining the present two. Detailed plans for this are nearly completed and construction has begun. If the contractors succeed in getting the building closed in with heat on before the winter, this construction should be complete early in 1952. This construction will complete for practical purposes an establishment which will accommodate a scientific staff of fifteen persons along with three to four groups of visiting investigators.

National Aeronautical Establishment

As noted earlier in this report, the NAE operates under the direction of the National Aeronautical Research Committee and is administered by the NRC on behalf of the Committee. DRB is actively concerned with the research program of NAE and will be contributing both funds and

staff for this purpose. The Board's primary task to date has been to provide the funds for and supervise the construction of the new facilities being erected at Uplands Airport for the Flight Research Section, which is at present located at Arnprior. Work on a hangar-laboratory, garage, cafeteria and steam power plant commenced in August, 1951, with a target completion date of September, 1952. The cost of this initial construction program is estimated at $2,250,000.

NAE is at present actively engaged on a test and development program to meet the needs of the RCAF. It is also working with CARDE on the aerodynamical aspects of the GM development.

Extramural Research

Research in the universities has continued in accordance with the pattern established in past years. Although it is recognized as undesirable to encourage university research workers to become too much immersed in applied and classified research problems, efforts to bring the scientists in DRB establishments in closer contact with those in the universities have met with considerable success. Research contracts with industry have become much more effective, chiefly because the rearmament programs of the Services have given rise to concrete problems suitable for solution in this manner.

The amount of DRB-sponsored research in other government laboratories has increased significantly. The Bureau of Mines has undertaken an important project designed to solve the problems involved in the refining and use of titanium. The Radio and Electrical Engineering Division of the NRC is devoting a considerable part of its resources to a defence program prepared in consultation with DRB. The Fisheries Research Board is continuing its oceanographic studies, and the Department of Agriculture, in addition to the work of Dr. Mitchell, mentioned earlier in this report, is carrying on with its work at Suffield and in northern Canada on biting insects. The Building Research Division of NRC has undertaken a number of civil defence projects and is also carrying on its studies in the field of snow and soil mechanics.

PROPOSED PROGRAM FOR THE FISCAL YEAR 1952-53

General

During the past year Canada's forces have gone into action in Korea and Canada has undertaken to provide units for the integrated force in Europe. This sudden transformation of the Canadian services from nucleus forces to forces in being has focussed attention on the immediate problems of new equipment. During the fiscal year 1952-53 all three Canadian armed forces will be expanding rapidly in order to meet their commitments under the North Atlantic Treaty. This process of expansion has already given rise to urgent problems requiring research or development. Many more such problems will arise in the forthcoming year. It is therefore obvious that the Defence Research Board must not only try to maintain most of its present activities but must also be prepared to expand its applied research and development in direct support of the immediate requirements of the armed services. The proposals for meeting this need are outlined below. The need will have to be met partly by increasing the Board's own staff, partly by using a greater percentage of other existing research facilities, especially at the National Research Council, and partly by an increasing use of the research and development facilities of industry.

Fields of Research and Development Requiring Expansion

The fields of activity in which the greatest expansion of effort will be required during the coming year are:

(a) Aeronautics, including the aerodynamic aspects of the guided missile program.
(b) Electronics, including the electronic aspects of the guided missile program.
(c) Military aspects of atomic energy.

Aeronautics

A good start has been made on the provision of essential laboratory facilities for NAE. The new runway at Uplands will be ready for use in 1952 and the construction program already launched will provide accommodation for an expanded staff.

It is intended that DRB should employ as many as twenty scientists and engineers for posting to NAE and employment on defence projects. The administrative arrangements in this connection are now under discussion by the National Aeronautical Research Committee.

There is an urgent need for increased facilities for static testing, including means for pressure-testing fuselages, and for two jet engine test stands. It has been agreed that these facilities should be located at Uplands, and if possible they will be incorporated in the 1952 program.

NAE is working closely with CARDE on the aerodynamic problems associated with the guided missile program and this work will be advanced at highest priority in 1952.

Electronics

Vigorous efforts were made during the past year to increase the effort devoted to the electronics research and development program. The expansion of the DRTE staff and the completion of the new Radio Physics and Electronics laboratories will help to further improve the situation. But it is obvious that the constantly increasing demands of the Services will require additional measures. For this reason it will be necessary to assign a larger number of suitable problems of an applied or "hardware" nature to industry. Provision will be made in the estimates for this purpose.

Military Aspects of Atomic Energy

Even although Canada is not involved in the production of the atomic bomb there are a number of pressing military needs related to atomic defence which involve research and development. During the past year DRCL has been working on a number of radio-chemical problems, SES has commenced a program of investigations on the field dispersal of radioactive material, the Physics Department of the University of British Columbia has continued its work on radiation counters which will function in extreme cold, and the Chemistry Department at the University of Saskatchewan has commenced an investigation of chemical detectors for radioactivity.

None of the projects referred to above are very large, and the scale of activity falls far short of that required. It is proposed, as a first step in remedying the situation, to employ a senior radio physicist

with general responsibility for the whole of the Board's program in this field. Efforts will also be made to employ additional radiochemists and electronics specialists for work on problems of atomic defence.

Other Fields of Research

It should not be concluded from the remarks above that the fields singled out for special mention have necessarily a higher priority than the other areas of defence research with which the Board is concerned. It is rather that the expansion of activity in such subjects as armament, special weapons, naval research, medical research, and operational research, is generally satisfactory, and that the projection of their current programs into the coming year will keep them fully occupied. There will, of course, be changes in detail, and the following notes indicate the most significant of these:

Armament Research

CARDE will concentrate on the GM project and the larger model of the Heller. Work on the pack howitzer and the sabot will be wound up as rapidly as possible, except for a possible requirement for the development of a 110 mm. sabot shell for the U.S.A. The proof activities of the Inspection Services located at CARDE are increasing rapidly. Efforts will be made this year to have this work moved to some other location.

Medical Research

The medical research program has grown very rapidly and is now approaching the planned limits of its expansion. The next task is a review of the program to focus effort on vital problems. This will be necessary both for DRML and for the extramural research program, and steps to accomplish this are already being taken.

Naval Research

The recent transfer of the dockyard laboratory at Halifax from the RCN to DRB has worked out very satisfactorily. As a consequence, the Navy has requested DRB to establish a similar unit as a part of the Pacific Naval Laboratory. This proposal is considered to be a sound one, but if it is acceded to, the construction plans for the new laboratory at Esquimalt will have to be modified as a larger building will be required.

Arctic Research

Up to the present, the program of research at DRNL has been, of necessity, fundamental in character. During the coming year, however, it is expected that it will be of a much more applied nature. An operational research team has already started work on a number of problems of immediate application to military operations in the Arctic. This winter a joint U.S.-Canadian team at Churchill will be conducting a series of CW field trials under arctic conditions.

The whole question of the conduct of field trials, both military and civil, at Churchill, is now under consideration. It is expected that one result of the discussion will be that DRB, and in particular DRNL, will play a much more active role in their planning and direction than in the past.

Special Weapons

The programs of research at SES, DRCL and GIES are proceeding satisfactorily. At DRKL work has been restricted due to lack of accom-

modation. The provision of a new building in 1952 will make it possible to develop a much larger and more active program.. At the same time, the DRB bacteriology fellowship plan which was launched this year will help to meet the resulting requirement for trained staff.

Operational Research

The principle limitation to the development of the operational research program is the lack of senior staff. Scientists with the requisite experience will be difficult to obtain, but as they are recruited it will be possible to increase the rate of activity on such important problems as the air defence system and military operations in the Arctic.

Construction Plans for 1952-53

During 1952-53, it is hoped to complete the following:

Micro-biological Laboratory	Kingston
Ballistics Laboratory and major extensions to the Machine Shop	Valcartier
Addition to Northern Laboratory	Churchill
Practically the whole of the Chemical Laboratory and Associated Respirator Development Laboratory and Pilot Plant (Shirley Bay)	Ottawa
A large proportion of the Medical Laboratory	Toronto
A large proportion of our commitment to the National Aeronautical Establishment	Uplands

In addition, it is hoped that we will be able to commence construction during 1952-53 on the following:

Pacific Naval Laboratory	Esquimalt
Single and Married quarters and the replacement of certain laboratories	Suffield
A much needed Administration Building	Valcartier
Central Stores and Workshop Building to serve the Chemical Laboratories and Radio Physics Laboratory (Shirley Bay)	Ottawa
Cold Weather Testing facilities	Churchill
Static Testing and Turbine Testing facilities for N.A.E.	Uplands
Guided Missile Range Facilities	(site under advisement)

Finances for 1952-53

As the detailed financial estimates of the research establishments are still being prepared, the following statement of requirements is tentative only.

The estimated financial requirements for defence research in 1952-53 total $24,500,000, as compared with $16,600,000 in 1952. The increase is accounted for as follows:

	1952-53	1951-52
Salaries and Wages: - provision for a staff of 500 scientists and 1600 supporting sub-staff by March, 1953	$6,500,000	$5,100,000
Operating Costs: - includes provision for equipping new laboratories, conversion of "La Have", Ice barge, R-102, and Early Warning projects, and unforeseen items	6,150,000	4,500,000
Extramural Grants and Contracts: - includes provision for grants and contracts with universities, and research contracts with industry for electronics, guided missiles, picrite, and deep-towed asdic projects	2,000,000	1,000,000
Construction: - includes provision for the program outlined in the preceding section of this report, together with necessary miscellaneous construction	9,850,000	6,000,000
TOTAL	$ 24,500,000	$ 16,600,000

B: SERVICE DEVELOPMENT PROGRAMS
(Prepared by the Services)

ROYAL CANADIAN NAVY DEVELOPMENT PROGRAM - 1952-53

The research and development program contemplated for 1952-53 will not differ appreciably from that of the previous year.

In the Electronics field, it is expected that this year will see the last of the necessary research and development for the Tactical Trainer. The research work which is necessary for the development of a specialized display system will be a continuing project and will be one of the major items in the RCN program.

The work which is being conducted in the National Research Laboratories Model Tank was considerably extended in the year 1951-52 and will continue for at least another year. Much valuable data have been obtained through this program.

Two relatively large items of research have been undertaken in connection with the Destroyer Escort program. The first one started was on experimental forgings for steam turbine rotors at temperatures of 950°F, the second was in conjunction with this and is the welding of steam lines to complement the work of experimental forgings. These items should be well toward completion in 1952-53.

Other miscellaneous items of the program are anti-fouling and anti-corrosion experiments, investigation of insulation for ships' hulls, and stabilizing equipment which is to be tried in the RCN Icebreaker. Work will continue on the large program set up to improve anti-submarine capabilities of the Navy and an up-to-date laboratory for chemical, metallurgical and radiological testing will be organized and functioning.

The estimated cost of the proposed naval development program for 1952-53 is $1,500,000.

CANADIAN ARMY DEVELOPMENT PROGRAM - 1952-53

1. The Army Development Program for 1952-53 is a continuation of that for 1951-52. The overall Army Development Program has not expanded as much as might have been expected due to the decision to adopt certain standard U.S. Army type equipments for use with the Canadian Army. The program continues to be coordinated with both the U.S. and U.K. to prevent unnecessary duplication and to ensure that standardization aspects are in conformity with the overall ABC program.

2. Certain projects have passed the development stage and are now in large-scale production and this has increased the burden of the development directorates acting in the design authority capacity in connection with these contracts.

3. In the armament field, emphasis will be placed on the finalization of design for the modification of AA equipment, the "Heller", sabot projectiles, light artillery pack equipment, radar and flame-throwers.

4. The development of engineer equipment will continue to stress prefabricated hutting, soil and snow mechanics and water supply in the field.

5. Electrical and communications development will be concentrated on radio sets and other equipment arising from the ABC standardization program and continued arcticization and miniaturization projects.

6. It is planned to place vehicle development priority on northland vehicles and problems arising from production in Canada of U.S. Army type vehicles.

7. Attached hereto as Appendix "A" is a list showing the major development projects with proposed expenditures for 1952-53. In addition to these, the sum of $200,000 is being sought for the administration of Army Development organizations.

8. The construction of a combined engineer and vehicle workshop and central heating plant is planned at RR 1, Montreal Road, Ottawa, and in this connection Army Development has provided funds in the amount of $400,000 to Defence Construction Limited. The total cost of this construction project will be in the neighbourhood of $650,000, and funds to that extent will be included in the 1952-53 estimates. Supervision of this contract demand is under the direct control of AHQ (DWA).

Ottawa, 10 September, 1951.

Appendix "A"

ARMY DEVELOPMENT PROGRAM

Activity	Estimated Requirements 1952-53
ARMAMENT AND AMMUNITION DEVELOPMENT	$ 2,700,000.00
Including development of:	
1. Light artillery pack equipment and related projectiles.	
2. Sabot type projectiles.	
3. Heller and related projectiles.	
4. Modifications and development of AA equipment including guns and fire control instruments.	
5. Radar equipment.	
6. Flamethrowers.	
ENGINEER DEVELOPMENT	118,000.00
Including development of:	
1. Prefabricated hut and related accommodation requirements.	
2. Soil and snow mechanics with relation to the construction of roads and airfields.	
3. Water supply in the Arctic.	
4. Tests and modifications of engineer construction equipment.	
ELECTRICAL AND COMMUNICATIONS DEVELOPMENT	560,000.00
Including development of:	
1. Portable radio sets and other equipment and component development arising from standardization.	
2. Arcticization and miniaturization projects.	
3. Line equipment and field wire requirements and components.	
VEHICLE DEVELOPMENT	1,400,000.00
Including development of:	
1. Northland prime movers, northland trailers and snow tractors.	
2. Design techniques arising from production in Canada of U.S. Army type vehicles. (This will be mainly body prototype work.)	
3. Carriers and armoured wheel vehicles.	
4. Light, medium and heavy bob sleds.	
5. Ancillary equipment and winter operation fittings.	
6. Vehicle mobility studies.	

Activity	Estimated Requirements 1952-53
CLOTHING, PERSONAL AND BARRACK EQUIPMENT DEVELOPMENT	$ 125,000.00

Including development of Clothing, Personal, Barrack Equipment and General Stores involving:

1. General development (textiles, leather, plastics, rubber, metals, specification methods.)
2. Development of clothing (Army clothing and equipment; RCN clothing and equipment; RCAF clothing and equipment)
3. Development of general stores (Army, RCN and RCAF general stores)

TOTAL ESTIMATED DEVELOPMENT REQUIREMENT:-	$ 4,903,000.00

ROYAL CANADIAN AIR FORCE DEVELOPMENT PROGRAM - 1952-53

The program of development to be undertaken by the RCAF in the fiscal year 1952-53 will consist mainly of projects directly associated with the defence of Canada. Funds in the amount of approximately $19,000,000 will be required to conduct research and development on aerodynamics, aircraft power plants, structures, fuels and lubricants, photographic equipment, armament, electronic equipment, instruments, and clothing and safety equipment.

The entire program has direct application to technical problems requiring urgent solution. As in the past, the fullest possible use of wartime aircraft and equipment is being made. The major items in this vote, accounting for more than sixty-five per cent of the total, are the jet fighter aircraft and gas turbine development programs. The jet fighter program, designed to provide the RCAF with a modern high speed, all-weather aircraft, has reached the stage where contracts have been let for quantity production and the development of new variants of the basic aircraft. To take full advantage of the aircraft's high performance, funds are also provided for the development and procurement of advanced armament and radar equipment. Development of the gas turbine program has also reached the stage where contracts have been let for the development of new variants of the basic engine.

The current development program of the RCAF can be divided into two main categories:

(a) new equipment;

(b) development of new Air Force operational techniques.

A. New Equipment

The development of the CF-100 twin-engine, all-weather Jet Fighter by A. V. Roe of Canada Limited, has made favourable progress during the year.

The production aircraft will be powered by Orenda engines and one such aircraft has already flown. Funds have also been provided for the development of an advanced fighter aircraft designated the CF-103.

The Orenda engine to date has accumulated 7000 hours of test time, including approximately 100 hours of flight test time. The Orenda engine is now in production and type testing of the production engines will commence in September. Funds have been made available for the development of a new engine designated the TR-8 to meet the requirements of the CF-103 aircraft.

The RCAF will collaborate with DRB in the development of Guided Missiles.

B. Development of New Air Force Operational Techniques

Work has continued on the collection of anti-icing and de-icing data. This project is carried on by the National Aeronautical Establishment using a North Star aircraft modified for this flight research.

An F86A has been instrumented for high speed research and allotted to the NRC to continue subsonic and transonic investigations in actual flight. The F86A aircraft will undertake investigation in those fields which cannot be done by the Mustang aircraft, although research still continues with the Mustang aircraft.

Future Program

Development will be continued on the major new equipment projects listed above.

The Central Experimental and Proving Establishment is carrying on the program of day-to-day development and performance testing. Research problems which are likely to arise out of the RCAF development program are as follows:

(a) High subsonic and supersonic aerodynamics including transonic;

(b) Thermodynamics in relation to turbojet engines;

(c) Physiological and psychological problems in relation to living and working under extremely adverse cold weather conditions;

(d) Physiological and psychological problems connected with high speed flight.

Appendix "A"

RCAF DEVELOPMENT PROGRAM

Activity	Estimated Requirements 1952-53
Aircraft Engines and Spares Development	$14,650,000.00
Instruments and Safety Equipment Development	205,000.00
Photographic Equipment Development	295,000.00
Armament Equipment and Facilities Development	2,090,000.00
Telecommunications Equipment Development	1,550,000.00
Special Experimental Projects	76,000.00
Total Estimated Development Requirements	$18,866,000.00(i)

Future Commitment Authority Requirement for 1953-54

Aircraft, Engines and Spares Development	$ 400,000.00
Instruments Equipment Development	20,000.00
Photographic Equipment Development	75,000.00
Armament Equipment Development	100,000.00
Telecommunication Equipment Development	405,000.00
Total Future Commitment Authority Requirement	$1,000,000.00

Note:

(i) This includes $1,045,000.00 carry over from 1951-52.

ANNUAL REPORT OF THE CHAIRMAN, DEFENCE RESEARCH BOARD

SEPTEMBER, 1951

COMPARISON OF ESTIMATES FOR 1951-52 AND

TENTATIVE ESTIMATES FOR 1952-53

(figures are to nearest $100,000 only)

Allocation	1951-52		1952-53	
	Cash	F.Y.C.	Cash	F.Y.C.
	$	$	$	$
Defence Research Board	16,600,000	5,600,000	24,500,000	6,000,000
Royal Canadian Navy	1,600,000	Nil	1,500,000	Nil
Canadian Army	4,100,000	700,000	5,100,000	800,000
Royal Canadian Air Force	12,700,000	950,000	18,900,000	1,000,000
Total	$35,000,000	$7,250,000	$50,000,000	$7,800,000